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Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Central South Dakota: Hughes and Sully Counties

E. O. Ullrich

J. T. Sanderson

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Department of Economics in cooperation with
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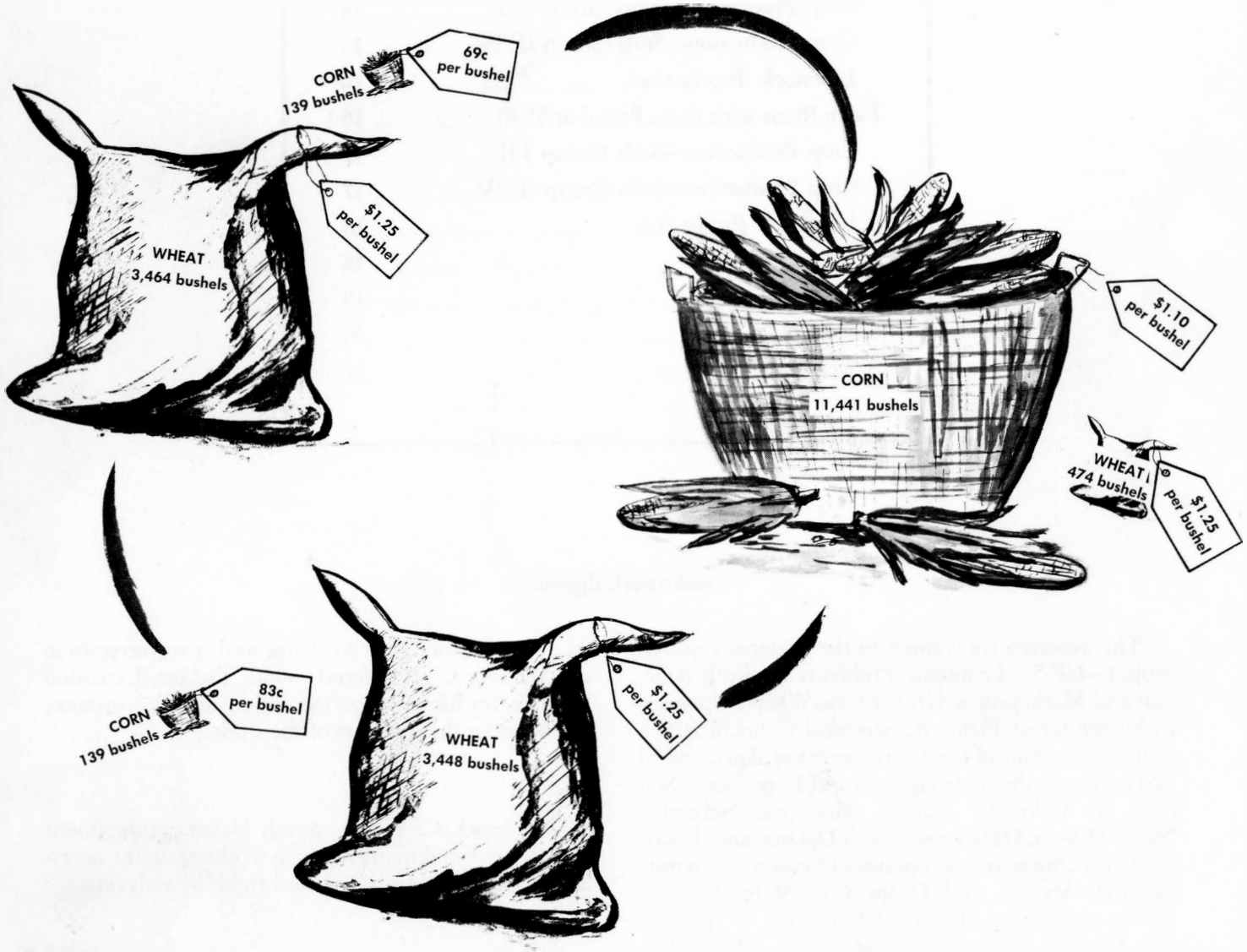

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Acknowledgments

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PREFACE

The purpose of this report is to present some results of a cooperative research project between the South Dakota Agricultural Experiment Station and the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture. This research contributes to a larger project—GP-5, "Economic Problems in the Production and Marketing of Great Plains Wheat."

The general objectives of the research undertaken in South Dakota were: (1) To provide economic data needed by farmers to make profitable adjustments in their farming systems and production practices and (2) To develop a research background for evaluating Government farm programs under varying assumptions.

Similar contributing projects to GP-5 were simultaneously conducted in most of the other Great Plains States. Objectives in the regional research project which were specifically related to production and farm management are as follows:

1. To develop information on technical production relationships and opportunities for grain farms in the Great Plains.
2. To determine the nature and magnitude of adjustments needed in specific farm situations which will achieve the most profitable systems of farming under a range of conditions with respect to prices of major products and quantities of available resources, such as land, labor, and capital, and to determine the quantities of resources required to provide selected levels of farm income.
3. To determine the effect upon total agricultural production, farm income, farm organization, and resources employed in the Great Plains if selected percentages of all farmers adjust to their most profitable farming systems for various assumed product demand conditions, factor or supply conditions and specific agricultural programs and institutional arrangements.

The South Dakota study area included 26 counties in Central South Dakota (Figure 1). This area normally accounts for about 68% of the state's wheat acreage, 43% of the feed grain acreage, 60% of the state's flax acreage, and about 55% of the total tame- and native-hay acreage. For analytical purposes, the GP-5 study area was divided into eight sub-areas on the basis of selected farm and soil characteristics and cropping practices.

The analysis of this study was based on possible adjustments on individual farming units. Thus, model farms were developed to represent a significant number, group, or segment of farms within a defined geographic area. Model farms were grouped on the basis of similar characteristics, plus similar alternative production opportunities.

Determining characteristics for grouping farms into model or typical farms included: Farm size, proportion of cropland to native hay and rangeland, soil characteristics, land use and tillage practices, farm organization and enterprise, labor use and labor availability.

In all, 14 model farms were developed in the eight sub-areas of the 26 county study—characteristics were so similar in four sub-areas that only one model farm was needed in each, but in the remaining areas there existed enough diversity to require three model farms in each of two sub-areas and two model farms in each of the other two.

Data used to develop model farms for each South Dakota study area and costs for crop and livestock enterprises for each model farm were derived from a variety of sources, which included: Farm surveys, Agricultural Stabilization and Conservation Service county office records, county assessor's records, U. S. Agricultural Census, S. D. State-Federal Crop and Livestock Reporting Service statistics, South Dakota State University Economics Department and actual cost data from machine dealers, insurance agents, and others.

The purpose of this bulletin is to present the most profitable combination of farm enterprises at various combinations of crop and livestock product prices on two different size model farms in Hughes and Sully Counties. The optimal farm plans presented herein are the results of computer programming using specific assumptions with regard to farm size and cropland acreage, crop yields, costs, commodity market prices, and other such factors.

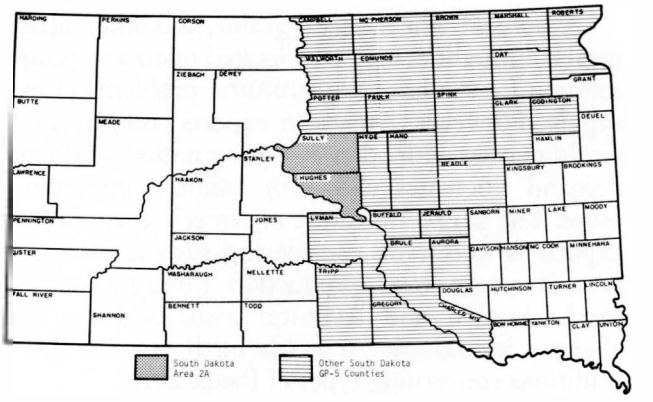

Figure 1. South Dakota GP-5 Study Area

Effect of Alternative Wheat and Feed Grain Prices on Optimum Farm Plans and Income in Central South Dakota, Hughes and Sully Counties

By Erwin O. Ullrich Jr. and
John T. Sanderson*

INTRODUCTION

The United States has witnessed rapid technological advances in agricultural production over the past several decades. At the same time, changes in the nature of demand also have occurred. These two phenomena have helped to create or further aggravate an imbalance between supply and demand for specific agricultural commodities. **Stated differently, the nation's productive capacity for wheat greatly exceeds the domestic needs and export demand at satisfactory prices under free market conditions.**

Associated with technological advancement in agricultural is the trend toward fewer and larger farms. In 1967, 31.5% of the nation's farms accounted for 85.1% of the total farm cash receipts.[1]

The upward trend in U. S. per capita income has been associated with a declining per capita consumptions of wheat and wheat products; total domestic consumption, however, remains fairly constant. With a continued increase in per capita income, the decline in per capita consumption of wheat can be expected to continue. As income levels rise, dietary changes also occur—usually from lower priced bulky and starchy foods to those which may be higher in protein as well as higher priced food items. Thus, there is now a growing tendency for people with rising incomes to view foods, once considered luxuries, as necessities. In addition, convenience foods now command an increasing share of the consumer's food dollar. The future level of total domestic demand depends upon the rate of population growth relative to the rate of increase in per capita income.

Exports of wheat, cereal grains, and other agricultural commodities are often looked upon as a possible solution for American agricultural problems of oversupply. However, American exports compete in the world market with other exporting nations and world demand fluctuates with crop failures and bumper crops. The long-term future of American agricultural exports is uncertain, considering such factors as increased world food production through increased mechanization and technical assistance programs, changes in attitudes towards birth control and in traditions concerning types of foods used.

The problem of farm adjustment thus centers around the changing demand for farm products and the continually changing technology.

The nature of desirable farm adjustment in the Great Plains becomes somewhat complicated by the limited number of feasible alternatives available due to relatively low rainfall and extreme variability of climatic conditions. Considering climatological and other related factors, there exists a comparative advantage in production of small grain (particularly in either hard red spring or winter wheat), depending upon the region of the Great Plains. Wheat, having a comparative advantage over other crops, means that the ratio of costs to yield favors wheat. Thus, wheat would be the most profitable crop alternative.

Thorough appraisals of adjustment opportunities on typical farms are needed to evaluate probable effects of farm programs and other external factors, and to guide farmers in making adjustment decisions.

TYPE OF AGRICULTURE IN AREA

The average farm size in Hughes County was 1,733 acres, compared with 1,831 acres in Sully County, according to the 1964 census. Average farm size is increasing annually and this trend is expected to continue. The Census of Agriculture in the period from 1959 to 1964 shows a slight percentage increase in farms under 500 acres but a decrease in farms between 500 and 999 acres, from 33.6 to 25.2% in this area. In contrast, farms of 1,000 acres or more increased from 41.5 to 47.6% in the same period.

Twenty-three per cent of the 634 farms in Hughes and Sully Counties were classified as cash grain and 62.5% as livestock (including ranches); the remaining 14.2% were general, dairy, poultry, and miscellaneous farms.

The major cash crop produced in this area is wheat, both spring and winter. Small acreages of rye and flax are also grown as cash crops. In addition, the quantities of feed grains sold off the farm in 1964 included: 87% of the grain sorghum harvested, 52% of the harvested corn-grain, and 56% of the oat crop. Feed grains which were not sold were fed to livestock on the farm.

Table 1 shows the number and percentage of farms in the two-county area that raised and harvested major grain crops in 1964.

*Agricultural economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, and assistant professor of economics, respectively, SDSU.

[1]Source: Farm Income Situation, July 1968.

Table 1. Number and Percentage of Farms on Which Major Grain Crops Were Raised and Harvested in 1964, Hughes and Sully Counties

Crop	Number of Farms	Percentage of Farms	Acres Harvested Number	Acres Harvested Per Cent
Corn*	450	71.0	80,507	29.1
All wheat†	432	68.1	121,477	43.9
Oats	436	68.8	50,465	18.2
Rye	42	7.1	8,638	3.1
Sorghum‡	142	22.4	9,503	3.4
Other§			6,292	2.3

*Includes corn harvested for grain, silage, and other purposes.
†Includes 40,125 acres of winter wheat and 7,498 acres of durum.
‡Includes sorghum harvested for grain, silage, and other purposes.
§Includes barley, flax, and proso.
Source: U. S. Census of Agriculture, 1964.

Livestock were found on about 90% of the area's farms. Beef cattle were kept on about 75% of the farms and herds were fairly large—50% of the herds were larger than 50 cows. Dairy enterprises were relatively small. Less than half of the farms with dairy cattle sold dairy products—either as whole milk or cream.

Relatively large hog enterprises were found on about a third of the area's farms. Approximately two-thirds of the hog producers in Hughes and Sully Counties farrowed more than 10 sows per year.

Most area ewe flocks numbered less than 200 head. Only about 1 in 5 farmers had sheep of some type.

MODEL WHEAT FARMS

Description

A farm sample, drawn in 1962, provided the basis for determining the model farms. Farms were stratified on the basis of various characteristics, such as farm size, proportion of cropland to native hay and rangeland, land use, and farm organization. Farms which differed greatly, such as those which did not have a wheat allotment or those which had either an unusually high or low proportion of cropland to total farmland, were not used to determine the model farm.

Two model farm sizes were selected in Hughes and Sully Counties. One was a 640-acre farm with 439 acres of cropland, 193 acres of native hay and pasture, and 8 acres of farmstead, roads, and wasteland. The other, a 1,600-acre farm, had 729 acres of cropland, 770 acres of native hay and pasture, and 101 acres of farmstead, roads, and wasteland. The size of the model farms chosen does not represent an arithmetic average—rather it is intended to represent the dominant size or sizes of wheat farms which will exist in the 1970s. One-fifth of the farms had fewer than 500 acres in 1964 and nearly the same number had between 500 and 999 acres. Some of these farms will survive and some will be enlarged by land rental or purchase. The nature of farm adjustment and farm organization would not differ significantly for farms larger than either the 640-acre or 1,600-acre farm provided the ratios of farmland, cropland, labor, and capital resources were about the same as for the model farms.

The crops and crop acreages on the representative farms were as follows:

Crop	Model Farm 640 Acres	Model Farm 1,600 Acres
All wheat	170	175
Oats	74	139
Corn Grain	38	96
Corn Silage	47	69
Sorghum Grain		17
Sorghum Silage		19
Other Crops	18	40
Summer Fallow	57	60
Alfalfa	35	92
Other Tame Hay and Pasture		22
Native Hay	68	308
Native Pasture	125	462

Soils

Several major soil associations are found in Hughes and Sully Counties. The Agar-Williams Association, in the western part of the area, occurs in undulating or sloping landscapes. These soils are well-drained with grayish-brown silt loam and loam surface layers. The major problems associated with these soils are: (1) Maintenance of organic matter and nitrogen, (2) Moisture conservation, and (3) Control of run-off. Livestock and general types of farming are best suited to the Agar-Williams soils area.

The Williams-Zahl Association soils are undulating to steep and are well to excessively drained. These soils have grayish-brown loam surfaces. The major management problems are similar to the soils of the Agar-Williams Association soils, namely: (1) Maintenance of organic matter and nitrogen supply, (2) Moisture conservation, and (3) Control of run-off and water erosion. The land use depends mainly upon topography and includes cash grain, livestock and general farming, and ranching.

The third soil association, found mainly in Hughes County, is the Raber-Eakin Association. These soils are undulating, well-drained grayish-brown loams, clay loams, and silt loams. The major problems in soil and water management associated with Raber-Eakin soils are: (1) Maintenance of organic matter and supply of nitrogen, (2) Maintenance of soil fertility, (3) Moisture conservation, and (4) Control of run-off and water erosion. Cash grain farming and ranching are best suited to the Raber-Eakin soils with the specific land use restricted by the land topography.

Each soil series and soil type, within the soil associations found in the two-county area, was classified into one of four groups on the basis of: (1) Land use, (2) Topography, (3) Potential soil hazards and problems, and (4) Management practices needed. Yield projections were developed under assumptions of normal weather conditions, recommended fertilizer usage, and specific management and rotation practices recommended for the productive capability of the soils (see Table 2). In cases where the soils of a particular group comprised less than 10% of the area's cropland, the soils of that group were combined with those of a second group and the yields were weighted accordingly.

A total of 24 crop rotations or sequences, including corn and sorghum, were selected for the two soil groups—15 rotations for Soil Group I-II and 11 for Soil Group III-IV (appendix Table 1). These rotations, chosen from a wide range of alternatives, were within the requirements of the various soils within each group.

Table 2. Crop Yields and Fertilizer Usage per Planted Acre by Soil Group, 640 and 1,200-Acre Model Farms, Hughes and Sully Counties

Crop and Rotation	Group I-II Soils			Group III-IV Soils		
	Projected Yield bushels	Fertilizer* Nitrogen pounds	P_2O_5 pounds	Projected Yield bushels	Fertilizer* Nitrogen pounds	P_2O_5 pounds
Winter Wheat on Fallow	24.6		15.5	17.2		10.5
Spring Wheat on Fallow	26.9		17.0	16.9		10.5
Spring Wheat after Corn	19.0	21.0	12.5	11.8	13.5	7.0
Spring Wheat after Small Grain	13.6	15.0	9.0	8.4		
Oats, Continuous Crop	39.2	16.0	13.0	30.3	12.5	10.0
Barley, Continuous Crop	28.8	17.5	12.0	22.2	13.0	9.0
Rye, Continuous Crop	19.0	10.0	11.5	14.1		9.0
Flax after Alfalfa or Row Crop	11.0		10.0	11.0		10.0
Corn Grain Continuous Crop	26.9	25.5	8.5	20.5	19.0	6.0
Corn Silage Continuous Crop	5.0†	28.0	9.5	3.85†	21.0	6.5
Grain Sorghum Continuous Crop	38.4	36.0	11.5	28.5	26.0	9.0
Forage Sorghum Continuous Crop	7.9†	39.5	12.5	5.85†	28.5	10.0
Alfalfa	1.6†			1.15†		
Native Hay	.5‡					

*Actual pounds applied per acre.
†Unit is in tons.
‡Native hay is harvested from noncropland.

The 640-acre model farm contained 391 acres of Group I-II soils and 48 acres in Soils Group III-IV. The 1,600-acre farm contained 649 acres of Group I-II soils and 80 acres in Soils Group III-IV.

Crop Alternatives

Cash grains, feed grains, and forage crops were considered as crop alternatives in this two-county area. The small grains included were: Hard winter wheat and spring wheat, flax, rye, barley, and oats. The other crops considered as alternatives included corn grain and silage, grain sorghum and forage sorghum, alfalfa, and grass and legume seeding for permanent pasture on cropland.

Flax and rye were grown strictly as cash crops while corn grain, grain sorghum, wheat, oats and barley could either be used as livestock feed or sold off the farm. The corn silage, forage sorghum, and alfalfa which may be produced on these farms would have to be fed to livestock and could not be sold off the farm. Native hay and pasture could either be used by the farm operator for cattle or be left unused.

A cost summary of the crop enterprise budgets considered is shown in Table 3. Costs included in the budgets were: Seed, fertilizer and spray materials, all fixed and variable machine costs, custom harvest costs when applicable, crop hauling to storage, and interest on operating capital. Interest charge on land was not included.

Livestock Alternatives

The livestock activities allowed included: (1) A cow-calf operation, (2) Raising calves to be sold as stockers, and (3) Buying calves to raise and sell as stockers. Fattening activities such as cattle feeding or raising hogs were excluded as enterprise alternatives; these livestock activities are not primarily land based and are somewhat independent of wheat production.

Feeding systems which were allowed as alternatives included: (1) A stocker ration with corn-silage and (2) A stocker ration without corn-silage.

Prices Received

Optimal farm plans were determined for various combinations of crop and livestock product prices. The market prices were held constant for flax at $2.30 per bushel, rye at 78 cents per bushel, feeder calves at $25.28 cwt., and stocker cattle at $23.08 cwt. Wheat prices were varied from zero cents to over $3 per bushel at corn price levels of 69 cents, 83 cents, and $1.10 per bushel. Oat and barley prices were converted to a corn equivalent based on feed value.

The flax, rye, and cattle prices are those which may be expected to occur in 1970 under certain assumed supply and demand conditions. The assumed grain prices are received at local elevators while the livestock prices are those received at the Sioux City Terminal Market.

Table 3. Total Man-Hours and per Acre Costs for the Crop Alternatives Budgeted for the 640- and 1,600-Acre Model Farms, by Soils Groups*

Crop	640-Acre Farm Total Man-Hours†	640-Acre Farm Costs per Acre for Soil Groups: I-II	640-Acre Farm Costs per Acre for Soil Groups: III-IV	1,600-Acre Farm Total Man-Hours†	1,600-Acre Farm Costs per Acre for Soil Group: I-II	1,600-Acre Farm Costs per Acre for Soil Group: III-IV
Summer Fallow	1.52	$3.38	$3.38	1.12	$3.59	$3.59
Winter Wheat after Fallow	1.47	10.69	10.20	1.38	9.59	9.12
Spring Wheat after Fallow	1.47	10.70	10.10	1.38	9.61	9.01
Spring Wheat after Corn	2.39	13.79	12.15	2.05	12.34	10.97
Spring Wheat after Small Grain	2.33	12.90	10.35	1.99	11.50	8.95
Oats	2.33	13.33	12.64	1.99	11.90	11.23
Barley	2.33	13.36	12.57	1.99	8.93	11.15
Rye	2.21	13.79	12.39	1.87	12.36	10.96
Flax after Row Crop	2.33	11.09	11.09	2.05	9.67	9.67
Flax after Alfalfa	2.79	11.09	11.09	2.45	9.67	9.67
Corn Grain	2.62	17.99	17.02	2.66	19.22	18.13
Sorghum Grain	3.00	17.06	15.67	3.16	16.82	15.43
Corn Silage	4.38	27.79	25.74	2.22	23.63	21.59
Sorghum Silage	4.38	26.91	24.47	3.16	22.75	20.31
Alfalfa	1.66	16.12	15.20	1.55	15.20	14.28
Native Hay, loose	.96	3.31	3.31	.72	2.93	2.93

*Excludes a charge for land.
†Excludes hauling and storing.

Table 4. A Summary of Budget Items for the Cow-Calf Herd and Stocker Calf Alternatives Considered for the 640- and 1,600-Acre Model Farm

Item	Cow-Calf Herd	Stocker Calves Wintered and Grazed with silage	Stocker Calves Wintered and Grazed without silage
Per Cent Calf Crop	92.0%		
Purchase Weight		430 lbs.	430 lbs.
Sales Weight	430 lbs.	700 lbs.	700 lbs.
Purchase Cost		$108.70	$108.70
Pasture	6.5 aum	3.25 aum	3.25 aum
Hay Equivalent	2.60 ton	.40 ton	.64 ton
Corn Silage		1.20 ton	
Corn Grain Equivalent	2.70 cwt.		3.60 cwt.
Variable Cash Costs*	$40.87	$25.94	$25.76
Allocable Fixed Costs†	$11.40	$ 6.90	$ 6.90
Labor per Head	12.0 hrs.	5.3 hrs.	5.3 hrs.

*Includes: Salt and minerals, protein supplement, veterinary and drugs, taxes, insurance, marketing, machinery and equipment cash expenses.
†Includes: Depreciation, insurance, taxes, and investment interest on machinery, buildings, and facilities used for enterprise.

Labor

The available labor supply was determined from data obtained in several recent farm surveys. Operator and family labor were combined and classified as resident labor. Hired labor, as a category, included regular and part-time help.

The work year was divided into five labor periods, each identified with a season or type of work usually expected to be performed in that period. However, the type of work performed in each period is not as clear-cut as the dates for each period since there is usually some overlapping of tillage, planting, and harvesting from one labor period to another.

The resident labor used for livestock and field crops could not exceed the number of hours allotted to each period, which were as follows:

For 640-acre model farm: (1) 899 hours, November 16 to March 15; (2) 474 hours, March 16 to April 30; (3) 920 hours, May 1 to July 15; (4) 924 hours, July 16 to September 30; and (5) 377 hours, October 1 to November 15. For 1,600 acre model farm: (1) 1,159 hours, November 16 to March 15; (2) 621 hours, March 16 to April 30; (3) 1,177 hours, May 1 to July 15; (4) 1,122 hours, July 16 to September 30; and (5) 484 hours, October 1 to November 15.

Labor could be hired in any or all periods but was restricted to the amounts used on sample farms. The hired labor wage rate was $1.25 per hour.

OPTIMUM FARM PLANS AT VARYING WHEAT AND FEED GRAIN PRICES

Linear programming is a method of analysis used to determine the farm plans which provides maximum net returns, given input factors such as crop and livestock enterprise costs, amount of available land, amount of available labor, capital requirements and availability, and product prices. This method of analysis was used to determine probable wheat and feed grain production which would optimize net income at various price combinations. Because linear programming solutions were obtained for a wide range of wheat prices, a large number of optimum farm plans resulted. Many of the optimum farm plans indicated insignificant changes in production or net income and will not be presented here.

Tables 5 through 10 show only major changes in crop acreages, crop and livestock production, labor, capital, and net returns at constant feed grain, flax, and cattle prices with increasing wheat prices.[2] Since minor changes in farm organization were not shown, breaks in the wheat prices are shown in the tables. The wheat prices are shown as a range over which the farm plans, crop and livestock production, and other such factors remain constant.

[2]The net returns referred to are to land, labor, and management.

Table 5. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $.57	$.74 to $.77	$1.01 to $1.42	$1.53 to $1.55	$1.56 to $3.20	$3.21
Crops (in acres):						
Wheat	48	125	137	152	216	218
Oats	62					
Flax	48	125	137	128		
Summer Fallow	48	125	137	152	216	218
Corn			7			
Sorghum		15	1	7	7	4
Tame Hay or Pasture	234	48	21			
Crop Production (in bushels):						
Wheat	1,234*	3,231†	3,464	3,693	5,364	5,407
Flax	490	1,284	1,403	1,313		
Feed Grain (corn equivalent)	1,127		139	43	43	56
Sorghum Silage (in tons):		120	7	43	43	14
Tame Hay	104		19			
Native Hay	34	34	34	34	34	34
Livestock (head):						
Beef Cows		1	18	9	9	12
Stockers Sold‡	216	76	13	27	27	9
Total Labor Use (hours)	1,888	1,339	1,178	1,178	1,078	1,013
Total Capital Used	$45,552	$22,957	$17,550	$17,038	$15,798	$13,340
Net Returns§	$ 3,075	$ 3,579	$ 4,470	$ 6,320	$ 6,392	$15,235

*Wheat fed to livestock.
†7 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor

Table 6. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $.45	$.62 to $.85	$1.15 to $1.30	$1.48 to $1.62	$1.63 to $3.59	$3.72
Crops (in acres):						
Spring Wheat	97	206	221	249	354	357
Oats	90					
Flax	97	206	221	209		
Summer Fallow	97	206	221	249	354	357
Corn			11			
Sorghum		30	21	21	21	16
Tame Hay or Pasture	349	80	34			
Crop Production (in bushels):						
Spring Wheat	2,503*	5,324†	5,580	6,049	8,781	8,846
Flax	994	2,115	2,262	2,146		
Feed Grain (corn equivalent)	1,630		204	234	234	255
Corn Silage (in tons):			6			
Sorghum Silage		237	168	109	109	65
Tame Hay	127					
Native Hay	154	154	154	154	154	154
Livestock (head):						
Beef Cows		37	43	49	49	53
Stockers Sold‡	438	148	109	68	68	40
Total Labor Use (hours)	3,704	2,927	2,888	2,673	2,510	2,372
Total Capital Used	$86,004	$50,540	$46,365	$41,387	$39,880	$36,289
Net Returns§	$ 7,274	$ 7,651	$10,502	$12,354	$13,265	$31,603

*Wheat fed to livestock.
†156 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor.

Table 7. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $.67	$.94 to $.95	$1.11 to $1.37	$1.49 to $1.53	$1.56 to $3.20	$3.21
Crops (in acres):						
Spring Wheat	6	39	136	144	216	218
Oats	8					
Flax	14	39	136	133		
Summer Fallow	6	31	136	144	216	218
Corn	109	8	7	4		
Sorghum	272	297	3	3	7	4
Tame Hay or Pasture	24	24	21	12		
Crop Production (in bushels):						
Spring Wheat	154*	894†	3,448	3,573	5,364	5,407
Flax	146	403	1,397	1,367		
Feed Grain (corn equivalent)	11,874	9,495	139	78	43	56
Sorghum Silage **(in tons)**		89	22	20	43	14
Tame Hay	21		18	13		
Native Hay	34	34	34	34	34	34
Livestock (head):						
Beef Cows	18	5	18	16	9	12
Stockers Sold‡	14	55	14	12	27	9
Total Labor Use **(hours)**	1,685	1,726	1,205	1,169	1,078	1,013
Total Capital Used	$22,687	$25,657	$17,775	$17,038	$15,798	$13,340
Net Returns§	$ 4,165	$ 4,304	$ 4,819	$ 6,141	$ 6,392	$14,235

*Wheat fed to livestock.
†156 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor.

Table 8. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $.42	$.52 to $.71	$.95 to $1.26	$1.48 to $1.62	$1.63 to $3.58	$3.59
Crops (in acres):						
Spring Wheat	59	89	222	249	354	357
Oats	65	13				
Flax	72	103	222	209		
Summer Fallow	8	89	209	249	354	357
Corn	13	13	13			
Sorghum	267	381	23	21	21	16
Tame Hay or Pasture	194	40	40			
Barley	51					
Crop Production (in bushels):						
Spring Wheat	844*	2,303†	5,525	4,049	8,781	8,846
Flax	767	1,052	2,274	2,146		
Feed Grain (corn equivalent)	11,225	12,578	272	234	234	255
Sorghum Silage **(in tons):**		78	185	109	109	65
Tame Hay	148	31				
Native Hay	154	154	154	154	154	154
Livestock (head):						
Beef Cows	98	64	42	49	49	53
Stockers Sold‡	74	49	115	68	68	40
Total Labor Use **(hours)**	3,741	3,255	2,878	2,673	2,510	2,372
Total Capital Used	$62,628	$48,762	$47,321	$41,387	$39,880	$36,289
Net Returns§	$ 8,154	$ 8,332	$ 9,392	$12,354	$13,265	$30,485

*Wheat fed to livestock.
†273 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor.

Table 9. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $1.18	$1.22 to $1.29	$1.59 to $1.72	$1.73 to $3.20	$3.20
Crops (in acres):					
Spring Wheat	6	21	46	60	216
Oats	1				
Flax	7	21			
Summer Fallow	6	21	46	60	216
Corn	134	21			
Sorghum	264	335	349	319	7
Tame Hay or Pasture	21	21			
Crop Production (in bushels):					
Spring Wheat	94*	474†	945	1,318	5,364
Flax	72	221			
Feed Grain (corn equivalent)	12,191	11,441	11,183	10,242	43
Sorghum Silage (in tons):	1	1	43	43	43
Tame Hay	24	24			
Native Hay	34	34	34	34	34
Livestock (head):					
Beef Cows	22	22	9	9	9
Stockers Sold‡		1	27	27	27
Total Labor Use **(hours)**	1,681	1,661	1,657	1,636	1,078
Total Capital Used	$21,781	$22,488	$22,694	$22,070	$15,798
Net Returns§	$ 7,409	$ 7,409	$ 7,634	$ 7,763	$ 7,910

*Wheat fed to livestock.
†273 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor.

Table 10. Crop and Livestock Production, Capital Needed, and Net Returns for the Optimum Farm Plan at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Item	Price of Wheat $.36 to $.88	$1.12 to $1.23	$1.38 to $1.62	$1.63 to $1.73	$1.74 to $1.84	$1.85 to $3.53
Crops (in acres):						
Spring Wheat	83	106	122	162	193	354
Oats	13	6				
Flax	96	90	82			
Summer Fallow	83	106	122	162	193	354
Corn	13	6				
Sorghum	402	395	405	405	343	21
Tame Hay or Pasture	40	18				
Crop Production (in bushels):						
Spring Wheat	2,129*	2,517†	2,750	3,813	4,608	8,781
Flax	982	918	835			
Feed Grain (corn equivalent)	13,560	12,898	12,756	12,756	10,753	234
Sorghum Silage **(in tons):**		73	109	109	109	109
Tame Hay	46	20				
Native Hay	154	154	154	154	154	154
Livestock (head):						
Beef Cows	77	60	49	49	49	49
Stockers Sold‡		46	68	68	68	68
Total Labor Use **(hours)**	3,155	3,203	3,192	3,129	3,085	2,510
Total Capital Used	$44,931	$47,169	$47,429	$46,840	$45,659	$39,880
Net Returns§	$11,558	$12,947	$13,590	$14,272	$14,690	$15,202

*Wheat fed to livestock.
†273 bushels of wheat were fed to livestock.
‡Includes calves raised and purchased.
§The net returns refers to the lowest wheat price and includes the returns to land and the operator's labor.

Farm Plans with Corn Priced at 69 Cents

Results of the linear programming indicate that at this price combination, net returns would be greatest with a farm organization oriented toward the production of the cash grains, primarily wheat and flax. A cattle enterprise was maintained on both model farms, but each enterprise was supplementary in nature. However, a substantial number of feeder calves were purchased, at the very low wheat prices, for growing out to stocker cattle weights. As the wheat prices rose, summer fallow and wheat acreage increasingly displaced feed crop acreage. Consequently, the large numbers of feeder calves were replaced by a relatively small stock-cow herd on both model farms.

In general, wheat acreage and production increased as the wheat price increased. The two main sources of income, at the low wheat prices, were derived from the sales of feed grains and stocker cattle.[3] But wheat became increasingly competitive as a cash grain when the wheat price rose while the other crop and livestock prices remained constant. The adjustment which takes place as the wheat price increases is a shift from feed grain and livestock feed crops first to wheat, flax, and summer fallow and then from flax to wheat and summer fallow. This change occurs at different price ratios for each of the model farms, because each farm has a different set of costs for the same crop enterprises. The change in crop rotations by soil group at the various wheat price levels are shown in Tables 11 and 12 for both model farms.

Crop Production—Soils Group I-II. Winter wheat, spring wheat, barley, oats, flax, corn-grain, grain sorghum, corn-silage, forage sorghum, alfalfa (including a pasture-type alfalfa), and summer fallow in combinations of 15 were the cropping alternatives considered. Continuous small grain was not allowed, although a continuous row crop was (both corn and sorghum). Corn is the only row crop shown in the crop rotations allowed, although sorghum can be substituted if it is more profitable. These soils are more productive since the crop yields (with the exception of flax and winter wheat) are higher than those yields on the other soils group. Flax yields are the same on both soils groups and winter wheat slightly outyields spring wheat on Soils Group III-IV.

The two most profitable crops were flax and grain sorghum when the wheat price was at 57 cents per bushel. Per acre returns for flax and grain sorghum, on the 640-acre model farm, were $12.49 and $5.83, respectively; returns from these crops were somewhat higher on the 1,600-acre model farm. Despite the profitability of flax and grain sorghum, the acreage of Soils Group I-II was devoted to 2 rotations, oats-alfalfa (3-years), and summer fallow-spring wheat-flax. Continuous flax was not allowed and could be grown

Table 11. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices					
	$.36 to $.57	$.74 to $.77	$1.01 to $1.42	$1.53 to $1.55	$1.56 to $3.20	$3.21
Soil Group I-II						
Oats, Alfalfa (3 years)	247.5					
Summer Fallow, Spring Wheat, Flax	143.5	375.8	390.1	384.2		
Sorghum		15.2	.9	6.8	6.8	3.5
Summer Fallow, Spring Wheat					384.2	387.5
Soil Group III-IV						
Grass	48.0	48.0				
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)			48.0			
Summer Fallow Winter Wheat				48.0	48.0	48.0

Table 12. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices					
	$.36 to $.45	$.62 to $.85	$1.15 to $1.30	$1.48 to $1.62	$1.63 to $3.59	$3.72
Soil Group I-II						
Oats, Alfalfa (3 years)	358.0					
Summer Fallow, Spring Wheat, Flax	291.0	619.0	627.7	628.0		
Sorghum		30.0	21.3	21.0	21.0	16.0
Summer Fallow, Spring Wheat					628.0	633.0
Soil Group III-IV						
Grass	80.0	80.0				
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)			80.0			
Summer Fallow, Winter Wheat				80.0	80.0	80.0

[3]Continuous corn and grain sorghum were allowed as crop enterprise activities. However, to reduce duplicating crop enterprise activities, only corn was used in crop rotations with the assumption that corn would be replaced by grain sorghum if it were the more profitable grain crop.

only in rotations of three or more years, and the feed grain and wheat prices were low in relation to the flax and livestock prices. Thus, the main source of income came from the combination of flax and livestock sales. The two crop rotations, which offered smaller cash returns than did grain sorghum, provided both grain and roughage for the livestock enterprise and grain for the cash grain market. The oat and flax production was sold; wheat and alfalfa were grown for the livestock.

An increase of 17 cents in the price of wheat, on the 640-acre farm, resulted in a shift of oat and alfalfa acreage to summer fallow-spring wheat-flax and to a relatively few acres of forage sorghum. The summer fallow-wheat-flax rotation replaced grain sorghum on the 640-acre farm as the most profitable cropping system with per acre returns of $5.86, compared with $5.83 for sorghum. With the same increase of 17 cents on the 1,600-acre farm, grain sorghum remained the most profitable crop, returning $6.07 compared with $5.59 per acre from summer fallow-wheat-flax; income from the livestock enterprise was still substantial. As the wheat price advanced to 85 cents per bushel, net returns from the rotation increased to $7.58 per acre. Thus, net returns were maximized by the same farm plans on both model farms, although the wheat price needed for the maximum returns on the 1,600-acre farm was lower than for the 640-acre model farm. This reflects economies of size, which is characterized by a lower breakeven point for larger sized enterprises or operations.

Very little change occurred in land use, on these soils, as the price of wheat rose. With the price rising above 77 cents per bushel, to a range of $1.01 to $1.55, the summer fallow-spring wheat-flax rotation remained the most profitable crop combination on the 640-acre model farm. Consequently, no major change in crop acreage occurred, although a few acres of forage sorghum were grown to provide silage for the livestock enterprise. The same is true for the 1,600-acre farm, summer fallow-spring wheat-flax remained the most profitable crop rotation as the wheat price rose above 85 cents, to a range of $1.15 to $1.62 per bushel. A few acres of forage sorghum were also grown to be harvested as silage for livestock. Net returns from summer fallow-wheat-flax averaged $8.19 per acre when wheat was priced at $1.01 per bushel, compared with $6.04 from summer fallow-wheat, the second best cropping alternative on the 640-acre farm. Net returns from the same rotations on the 1,600-acre farm at a wheat price of $1.15 per bushel were $10.17 per acre for summer fallow-wheat-flax. The second most profitable combination of summer fallow-wheat returning $8.30 per acre.

Wheat became more profitable than flax with a further increase in wheat price, to $1.56 per acre for the 640-acre farm and to $1.63 per acre for the 1,600-acre farm. Summer fallow-wheat produced returns of $13.16 compared with $12.94 per acre from fallow-wheat-flax on the 640-acre farm and $14.51 compared with $14.31 for the same rotations on the 1,600-acre farm. Consequently, the flax acreage, 128 acres on the 640-acre farm and 209 acres on the 1,600-acre farm, shifted to summer fallow and flax. Thus, the only acreage other than that used for the production of wheat was 7 acres of forage sorghum on the 640-acre farm and 21 acres on the larger farm. The sorghum acreage was reduced slightly on both farms as wheat advanced to $3.21 and to $3.72 per acre on the 640-acre and 1,600-acre farms, respectively. The reduction in sorghum acreage came with a change in the livestock enterprise—an increased number of stock-cows replaced purchased feeder calves.

The maximum wheat acreage possible, under the rotational restrictions for this group of soils, amounted to 66% of the cropland—the maximum possible production being attained from a wheat-fallow rotation. Thus, under the assumed crop and livestock prices, net returns from crop and livestock enterprises were maximized with 193.75 acres each in spring wheat and summer fallow on the 640-acre farm and 316.5 acres each in wheat and summer fallow on the 1,600-acre farm. The balance of the cropland was in forage sorghum to be used for the livestock enterprise. Wheat production reached 99.1% of the maximum possible allowed on the 640-acre farm and 97.5% on the larger farm. The net effect of a program with 1 year of fallow and 2 years of wheat was to reduce total wheat production and to raise the costs of production. The wheat yield after small grain is about half that on fallow and the costs of production are considerably higher.

Crop Production—Soils Group III-IV. Most of the crop alternatives were the same as on Group I-II soils. Rye, in a crop rotation, and a permanent grass and legume seeding for pasture were added as cropping alternatives. These soils were less productive; crop yields were smaller, with the exception of winter wheat and flax, and the costs of producing a bushel of grain were higher. Group III-IV soils comprised only 12.3% of the cropland and could not figure prominently in cash grain production. The crop rotations allowed, other than wheat-fallow, included 3 and 4 years of alfalfa.

The entire acreage of Group III-IV soils was seeded as tame pasture at wheat prices which ranged up to 77 cents for the 640-acre farm and 85 cents per bushel for the 1,600-acre model farm. Since livestock prices were relatively higher than wheat and feed grain prices, tame pasture returned more income than if it were used for cash crop production. Crop rotations

which included flax, corn, and wheat produced returns of about $1 per acre.

Flax was the most profitable crop, returning a net of $12.49 per acre when produced on the 640-acre farm and $13.91 per acre on the 1,600-acre farm. Grain sorghum, the next most profitable crop, returned a net of about $1.50 per acre with corn priced at 69 cents per bushel. Returns from the other crops were all negative. Although flax and grain sorghum were profitable, continuous flax, small grains, or row crops were not allowed. Hence, net returns at these low wheat and feed grain prices were either very low or were negative.

A rise in wheat price, to a range of $1.01 to $1.42 per bushel on the 640-acre farm and to $1.15 to $1.30 on the 1,600-acre farm, resulted in a shift from tame pasture to a summer fallow-spring wheat-corn-flax-alfalfa (3 years) rotation. Cash returns, from this rotation, on the 640-acre farm were $1.74 per acre compared with $1.29 from wheat-fallow at a wheat price of $1.01 per bushel. In addition, the alfalfa was available as livestock feed. Cash returns (on the 1,600-acre farm) from the same rotation at a wheat price of $1.15 per bushel were $2.60 per acre compared with $3.05 per acre from wheat-fallow.

A further rise in wheat price, to $1.53 per bushel on the 640-acre farm and to $1.48 per bushel on the 1,600-acre model farm, resulted in a shift of the entire Group III-IV soils to summer fallow-winter wheat. Winter wheat had a slight cost and yield advantage over spring wheat on these soils. The net returns from fallow-winter wheat on the 640-acre farm were $5.43 per acre at a wheat price of $1.53 per bushel, and, for the 1,600-acre farm, net returns were $5.64 per acre at a wheat price of $1.48 per bushel. The maximum wheat acreage and production was reached, on both farms, at these wheat prices, and wheat production from fallow-winter wheat would remain unchanged unless either feed grain or flax prices, or both rose enough to become a competitive factor, assuming no change in the costs of production.

Livestock Production. The livestock enterprise in the optimum farm plan was one of raising calves to stocker weights (700 pounds). Most of the calves were purchased in the fall and some calves were raised from a stock-cow herd.

The livestock enterprise contributed significantly to total farm income on both farms at the lower wheat prices, but as wheat rose in price, the livestock enterprise became supplementary in nature. Without any livestock, some land resources would remain idle. No provision was made to sell or rent out native hay or range. It is recognized that in most real situations, native hay or range land probably would not remain idle. If not used by the farm operator, it would be leased out.

With the $25.28 and $23.08 prices used for feeder and stocker calves, respectively, both were profitable, particularly at a corn price of 69 cents per bushel. In reality, such a large disparity between grain and livestock prices probably would not occur, or if it did it would not remain for long since the demand for corn for livestock feeding would force corn prices to rise. The livestock enterprise was profitable with this combination of crop and livestock prices. However, the size and nature of the livestock enterprise was influenced by the increase in wheat price as cropland shifted to a larger wheat acreage and fewer acres in feed crops. The cattle enterprise became relatively less profitable as wheat rose in price. Thus, the livestock enterprise on both model farms became a supplementary enterprise which existed to utilize native hay and range. At the higher wheat prices, only a few acres of cropland were used to produce livestock feed.

The livestock enterprise, on both model farms, consisted entirely of fall purchased calves at the low wheat price range. These enterprises gradually shifted from purchased calves to cow-calf enterprises as wheat advanced in price. As cropland acres increasingly shifted over to wheat, due to the higher prices, the grains and roughages fed also changed. Spring wheat and tame hay fed at the low wheat price range were replaced by grain sorghum and sorghum silage.

Fall purchased calves fed to stocker cattle weights (700 pounds) were relatively more profitable than maintaining a stock-cow herd. In addition, more labor is needed to maintain a stock-cow. Also, more of the labor is needed at a time when it competes with crops. Less short-term capital is required to maintain a stock-cow herd than to purchase feeder calves, but if owned capital or credit is ample, there then is no problem.

Feed, other than minerals, feed additives, and salt, was homegrown and consisted of hay, corn, and sorghum silage, and some grain. The grains used for feed depended upon the price of wheat in relation to corn, since the main enterprise was cash grain and crop rotations changed as wheat increased in price. All the spring wheat grown was used as feed on the 640-acre farm when wheat was priced from 36 to 57 cents and on the 1,600-acre farm at wheat prices of 36 to 45 cents. As the wheat price increased, spring wheat and tame hay were replaced by grain sorghum and sorghum silage.

The percentage of cropland used for feed production on the 640-acre farm varied from 72.1% at the low wheat price to 1% at the highest programmed wheat price. On the 1,600-acre farm, the percentage of cropland used for feed production varied from 68.7% at wheat prices of 36 to 45 cents to 2.5% when wheat reached $3.72 per bushel.

Farm Plans with Corn Priced at 83 Cents

Differences in farm plans occurred on both model farms, at the low wheat prices, when the corn price was raised to 83 cents from a 69-cent per bushel level. Crop production was shifted from wheat, oats, flax, and forage crops to corn and grain sorghum. Far fewer feeder calves were purchased, as the main source of farm income was now derived from sales of feed grain. Livestock became a supplementary enterprise on the 640-acre model farm at the low wheat price.

Due to the 17-cent increase in corn price and an increased volume of feed grain sold, net returns were higher on the 640-acre farm for the first three farm plans (Table 7). At wheat prices of $1.49 per bushel or higher, net returns were the same as when the corn price was 69 cents per bushel. Higher net returns were derived in the first two farm plans for the 1,600-acre farm, due to the increase in corn price on an increased volume of feed grain sold (Table 8). Net returns were the same with wheat priced $1.48 per bushel or higher as when corn was priced at 69 cents per bushel.

The change in crop rotations by soil group at the various wheat price levels are shown in Tables 13 and 14 for both model farms.

Table 13. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices					
	$.36 to $.67	$.94 to $.95	$1.11 to $1.37	$1.49 to $1.53	$1.56 to $3.20	$3.21
Soil Group I-II						
Summer Fallow, Spring Wheat, Flax, Corn	23.7					
Corn	95.3					
Sorghum	272.0	297.1	2.7	2.5	6.8	3.5
Summer Fallow, Spring Wheat, Flax		93.9	388.3	388.5		
Summer Fallow, Spring Wheat					384.2	387.5
Soil Group III-IV						
Flax, Corn, Oats, Alfalfa (3 years)	48.0					
Spring Wheat, Corn, Flax, Alfalfa (3 years)		48.0				
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)			48.0	26.9		
Summer Fallow, Winter Wheat				21.1	48.0	48.0

Crop Production—Soils Group I-II. Crop production on the 640-acre farm was oriented toward feed grain production at wheat prices of a dollar or less. At wheat prices up to 67 cents per bushel, grain sorghum was the most profitable crop and accounted for 272 acres, or nearly 70% of Group I-II soils. Corn grain accounted for nearly 26% of the cropland, while the balance of the acreage, approximately 18 acres, was evenly divided between summer fallow, spring wheat, and flax. The grain sorghum, corn, and flax were sold while the spring wheat was fed.

Crop production on the 1,600-acre farm was also oriented toward feed grain production at low wheat prices, but to a lesser degree, since the livestock enterprise was a commercial herd consisting of 98 cows. At a wheat price of 42 cents per bushel and corn priced at 83 cents per bushel, grain sorghum was the most profitable crop with net returns of $10.71 per acre. A restriction on the amount of family labor available in Period 5 and the need for livestock feed limited the grain sorghum acreage to 41% of this soils group cropland. Thus, spring wheat, oats, flax, corn, and alfalfa were grown in several crop rotations with summer fallow, although each was less profitable than grain sorghum either by itself or in combination with other crops. Corn grain, oats, and flax were sold while the spring wheat and alfalfa were fed.

Table 14. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices					
	$.36 to $.42	$.52 to $.71	$.95 to $1.26	$1.48 to $1.62	$1.63 to $3.58	$3.59
Soil Group I-II						
Flax, Spring Wheat, Corn, Oats, Alfalfa (3 years)	359.5					
Summer Fallow, Spring Wheat, Flax	22.9	267.8	625.7	628.0		
Sorghum	266.6	381.2	23.4	21.0	21.0	16.0
Summer Fallow, Spring Wheat					628.0	633.0
Soil Group III-IV						
Flax, Corn, Oats, Alfalfa, (3 years)	80.0	80.0				
Spring Wheat, Corn, Flax, Alfalfa (3 years)			80.0			
Summer Fallow, Winter Wheat				80.0	80.0	80.0

With an increase in wheat price to 94 cents per bushel, summer fallow-spring wheat-flax became the second most profitable crop combination, on the 640-acre model farm, with net returns which averaged $7.67 per acre. This compared with per acre returns of $10.47 from grain sorghum. The switch from corn grain to fallow-wheat-flax allowed sorghum acreage to expand, since sorghum acreage, together with corn, was limited due to the family labor available in Period 5. The increase in sorghum acreage was for silage fed to purchased feeder calves. Spring wheat, flax, and all but a few bushels of feed grain was sold.

A similar change in crops occurred on the 1,600-acre farm when wheat advanced in price to a range of 52 to 71 cents per bushel. Grain sorghum continued to be the most profitable crop, but with labor limiting the acreage, an increase in sorghum could be possible only with a decrease in corn acreage. Wheat's profitability in relation to corn increased with the higher wheat prices, and the switch to increased flax and wheat acreage allowed further expansion in sorghum acreage. However, alfalfa was no longer raised on Group I-II soils and some of the sorghum acreage increase was forage sorghum for silage. This change in crop acreages was accompanied by a decrease in cow herd numbers as the emphasis on cash grain enterprises increased.

Sorghum acreage, on the 640-acre farm, shifted to summer fallow-spring wheat-flax when wheat reached $1.11 per bushel and the resultant acreage remained unchanged through a price of $1.53 per bushel. The fallow-wheat-flax combination returned an average net of $11.29 per acre with wheat priced at $1.37 per bushel, and $12.52 at a price of $1.53 per bushel compared with $10.47 from grain sorghum. A fallow-spring wheat rotation was slightly less profitable, at the same wheat prices, but was more profitable than grain sorghum. However, when wheat reached $1.56 per bushel, summer fallow-spring wheat returned a net of $13.16 per acre, and flax, which returned only $12.49 per acre, was no longer grown in the rotation. From this point on, the cropping system became the same as when corn was worth only 69 cents per bushel —summer fallow-spring wheat and a few acres of sorghum, for silage, were grown.

A similar pattern occurred on the 1,600-acre farm, although there were several differences. Although the schedule of wheat prices at which rotational changes occurred was identical, the percentage of feed crop acreage was slightly higher due to the larger-sized livestock enterprise. Grain sorghum acreage, which was limited by the available family labor and the cost of hired labor, became relatively less profitable as wheat prices rose. Thus, when wheat reached 95 cents per bushel, sorghum acreage shifted to summer fallow-spring wheat-flax. At wheat prices of $1.26, $1.48 and $1.62 per bushel, fallow-wheat-flax returned an average of $11.11, $13.01, and $14.22 per acre, respectively. Fallow-spring wheat was the second most profitable crop combination at those wheat prices, but as wheat reached $1.63 per bushel, spring wheat became more profitable than flax and, consequently, the flax acreage was shifted to summer fallow-spring wheat. Thus, at a wheat price of $1.63 per bushel, the cropping pattern became identical to that when corn was priced at 69 cents per bushel.

Crop Production—Soils Group III-IV. Flax-corn-oats-alfalfa (3 years), on the 640-acre model farm, returned a net of $1.99 per acre plus alfalfa hay with corn priced at 83 cents per bushel. At wheat prices below 94 cents per bushel, any cropping system which included spring or winter wheat produced returns considerably below that crop rotation. But, as wheat rose to a price of 94 cents per bushel, spring wheat became more profitable, returns per acre averaging $2.02, and replaced oats in the rotation. Spring wheat on fallow replaced wheat on continuously cropped land, at wheat prices of $1.11 to $1.37 per bushel, as it then became more profitable. Net returns from this latest rotation (Table 13) averaged $2.38 per acre at a wheat price of $1.11 and $2.97 per bushel at a wheat price of $1.37 per bushel. Winter wheat on summer fallow became competitive as wheat continued to rise in price. At a price of $1.49 per bushel, total wheat and summer fallow acreage doubled—the increase was due to planting winter wheat. A corresponding and proportionate acreage reduction in alfalfa, corn, and flax acreage was necessary for wheat and summer fallow acreage to increase. The cropping pattern of winter wheat-summer fallow became the same as when corn was priced at 69 cents per bushel at wheat prices of $1.63 per bushel and higher.

The pattern of crop acreage changes and the wheat prices at which these changes occurred were somewhat different on the 1,600-acre farm. Although crop production costs and break even prices were lower on the larger farm, the primary reason for the slight difference in cropping patterns was the relative importance of livestock on the larger farm. Flax-corn-oats-alfalfa (3 years) returned an average net of $2.26 per crop acre (excluding alfalfa at a corn price of 83 cents) compared with spring wheat-corn-flax-alfalfa (3 years) which returned $2.09 per acre with wheat priced at 71 cents per bushel. Winter wheat-fallow at the same wheat price, provided negative returns of $2.08 per acre. Other rotations, which were allowed as alternatives, were similarly less profitable than the flax-corn-oats-alfalfa (3 years). Spring wheat replaced oats in the rotation as the net returns rose to an average of $2.52 per acre with an increase to 95 cents per

bushel in wheat price. A rotation which included summer fallow was slightly more profitable, but a labor limitation was responsible for its exclusion from the overall farm plan. At a wheat price of $1.26, the spring wheat-corn-flax-alfalfa (3 years) rotation returned an average of $3.08 per acre compared with $6.83 per acre for winter wheat-fallow, but the market value of alfalfa was not figured in the cash return of $3.08 per acre. As the wheat price reached $1.48 per bushel, the returns from winter wheat-summer fallow reached $8.61 per acre. As winter wheat-summer fallow became the most profitable crop combination, total acreage of Group III-IV soils was shifted to winter wheat-fallow.

Production of winter wheat, on both model farms, would remain unchanged at the higher wheat prices unless either feed grain or flax prices, or both, rose enough to become a competitive factor, assuming no change in the costs of production.

Livestock Production. The changes in the livestock enterprise which accompanied the increase in corn price occurred on the 640-acre model farm at wheat prices below $1.56 and $1.48 per bushel on the 1,600-acre farm. The changes were essentially substituting a stock-cow herd for purchased calves. The greatest change in the livestock enterprise occurred at the two lowest ranges of wheat prices on both model farms. The livestock enterprise on the 640-acre farm remained supplementary in nature while that of the 1,600-acre model farm was of such size that it would be classified as being commercial.

Changes in land use would suggest a change in feeding. Although the 14-cent rise in corn price created some change in land use, the main change involved the number of acres planted. Thus, aside from a change from tame pasture to tame hay, only the total feed supply changed with the changing number of animal units in the livestock enterprise.

Farm Plans with Corn Priced at $1.10

The competitive position and relative profitability of corn was further enhanced with an increase in corn price to $1.10 per acre. This would force a rise in the price of wheat if it were to remain on a competitive level with corn for the use of cropland.

Crop rotations by soil groups at the various levels of wheat prices are shown in Tables 15 and 16 for the two model farms.

Crop Production—Soils Group I-II. With a rise of 27 cents in the corn price, to $1.10 per bushel, wheat was not profitable enough to raise on the 640-acre model farm on these soils, even at a price of $1.18 per bushel. Considering the cost, yield and price relationships, continuous grain sorghum was the most profitable crop with a return of $19.43 per acre. Continuous corn was second with a return of $11.60 per acre, summer fallow-spring wheat-flax-corn produced an average return of $10.14 per acre and summer fallow-spring wheat returned only $8.24 per acre. A labor limitation during late summer and fall restricted the acreage of grain sorghum to 264 acres, and the balance of Group I-II soils were planted to corn.

Although an increase in wheat price, to $1.22 to $1.29 per bushel, narrowed the profit gap between wheat and corn, corn remained the more profitable crop. However, at the $1.22 per bushel wheat price, about 112 acres of corn were shifted to 70 acres of grain sorghum, with about 14 acres each going to summer fallow, spring wheat, and flax. The resultant shift of 42 acres to summer fallow, wheat, and flax altered the labor demands enough that 70 additional

Table 15. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices				
	$.36 to $1.18	$1.22 to $1.29	$1.59 to $1.72	$1.73 to $1.80	$1.84 to $3.20
Soil Group I-II					
Corn	126.6				
Sorghum	264.4	334.9	348.1	319.3	6.8
Summer Fallow, Spring Wheat, Flax, Corn		56.1			
Summer Fallow, Spring Wheat			42.9	71.7	384.2
Soil Group III-IV					
Flax, Corn, Oats, Alfalfa	6.5				
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)	41.6	48.0			
Summer Fallow, Winter Wheat			48.0	48.0	48.0

Table 16. Crop Rotations by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Cropland Acres at the Following Wheat Prices					
	$.36 to $.88	$1.12 to $1.23	$1.38 to $1.62	$1.63 to $1.73	$1.74 to $1.84	$1.85 to $3.53
Soil Group I-II						
Summer Fallow, Spring Wheat, Flax	247.6	250.8	244.4			
Sorghum	401.5	398.2	404.6	404.6	343.2	21.0
Summer Fallow, Spring Wheat				244.4	305.8	628.0
Soil Group III-IV						
Flax, Corn, Oats, Alfalfa (3 years)	80.0	35.5				
Summer Fallow, Winter Wheat		44.5	80.0	80.0	80.0	80.0

acres could be shifted from corn to the more profitable grain sorghum. Without the increase in wheat price, the profit spread between corn and wheat was a little too great, but with the increase, the additional profit from grain sorghum more than made up the loss in per acre profits accruing to the shift of corn to summer fallow and spring wheat.

A price rise to a range of $1.59 to $1.72 per bushel further increased the profitability of wheat with switching of flax and corn acreage to summer fallow, spring wheat, and grain sorghum. Spring wheat-summer fallow returned a net profit of $13.55 per acre at the price of $1.59 per bushel and $15.24 at a wheat price of $1.72 per bushel. Although the net returns from spring wheat-fallow were only 75 cents to $1.60 higher per acre than the combination of fallow-spring wheat-flax-corn, spring wheat-fallow was the second most profitable rotation. With an increase of 1 cent more per bushel, about 30 acres of grain sorghum were shifted to spring wheat-fallow with a total net profit of about $130. Although gross returns were reduced by $492 there was enough cost savings and reduction in use of capital and credit to post the net profit increase. One further increase, to $1.84 per bushel shifted grain sorghum to summer fallow-spring wheat, even though grain sorghum was slightly more profitable. The shift from grain sorghum reduced labor requirements by about 34%, capital use by about 29%, and annual credit by 33%. Just enough sorghum acreage was planted to supply the livestock enterprise with silage and grain. At the high end of the wheat price range, $3.20 per bushel, the fallow-spring wheat rotation returned $34.40 per acre.

Crop acreages and rotations, on the 1,600-acre model farm, followed a slightly different trend. Although grain sorghum was the most profitable crop, labor availability during the late summer and fall limited the grain sorghum acreage to about 62% of the Group I-II soils. Summer fallow-spring wheat-flax, at a wheat price of 88 cents, was second in profitability, returning an average of $7.83 per acre, and this rotation thus occupied the balance of the cropland in this soils group. A rise in wheat, to $1.12 to $1.23 per bushel, increased net returns from the fallow-wheat-flax rotation by $2.08 to $3.03 per acre, not nearly enough to become competitive with the returns from grain sorghum. Nevertheless, about 3 acres of sorghum were shifted to the fallow-wheat-flax rotation, because of crop rotations on the Group III-IV soils.

Higher wheat prices, ranging from $1.38 to $1.73 per bushel, had no effect on grain sorghum acreage as per acre returns from the second and third most profitable crop rotations were far below the $19.67 return from sorghum. But as wheat prices rose, the competitive advantage of flax over spring wheat diminished —with wheat priced $1.38 per bushel, the returns from summer fallow-spring wheat-flax were $12.15 per acre, compared with $11.27 from summer fallow-spring wheat. At a wheat price of $1.63 per bushel, summer fallow-spring wheat-flax returned an average of $14.31 per acre, compared to $14.51 from summer fallow-spring wheat; consequently, the acreage in flax shifted to summer fallow and spring wheat.

A wheat price of $1.74 per bushel increased the profitability of wheat somewhat and a shift of about 60 acres of grain sorghum to summer fallow and spring wheat occurred at that price. The effect of this change on net income was minimal, labor requirements were slightly reduced, annual capital requirements were reduced, and the amount of credit needed was less. Sorghum acreage decreased by 321 acres as the wheat price increased to $1.85 per bushel—the acreage evenly divided between summer fallow and spring wheat. Summer fallow-spring wheat, at a wheat price of $1.85, was slightly less profitable than grain sorghum but significant decreases in labor, capital, and credit needed occurred at this point. With a $2 price for wheat, net returns were comparable with grain sorghum and with the upper wheat price limit, fallow-spring wheat returned an average of $39.12 per acre. The 21 acres of sorghum were used to produce silage and grain for the livestock enterprise. Any further increase in wheat production would undoubtedly result in reduced farm income, since some of the cropland acreage was used for the livestock enterprise which otherwise would have to be reduced.

Crop Production—Soils Group III-IV. With wheat priced at $1.18 per bushel, only 24 cents per acre separated net returns from a flax-corn-oats-alfalfa (3 years) rotation and summer fallow-spring wheat-corn-flax-alfalfa (3 years) on the 640-acre model farm. However, due to the labor requirements, most of the acreage was devoted to the latter rotation, and with an increase in price to $1.22 per bushel, the remaining acreage shifted to the fallow-spring wheat-corn-flax-alfalfa (3 years) rotation. Summer fallow-winter wheat was less profitable than the other two rotations at wheat prices of $1.29 per bushel or less, but at a price of $1.59 per bushel, returns were $5.90 per acre compared with $4.26 per acre for a summer fallow-spring wheat-corn-flax-alfalfa (3 years) rotation and $3.57 per acre for flax-corn-oats-alfalfa (3 years). Thus, fallow-winter wheat being the most profitable at a wheat price of $1.59 per bushel, provided net returns of $7.02 per acre at a price of $1.73 per bushel, $7.89 per acre when wheat was priced at $1.84 per bushel, and $18.70 per acre with wheat priced at $3.20 per bushel.

The same trend occurred on the 1,600-acre, farm with one exception. With wheat priced at 88 cents per bushel any rotation with wheat was less profitable than the flax-corn-oats-alfalfa (3 years) rotation. But

as the price increased to $1.12 per bushel, the relative profitability of wheat increased and 44 acres of the 6-year rotation were shifted to fallow-winter wheat. A further increase in price, to $1.38 per bushel, made fallow-winter wheat the most profitable rotation allowed on the Group III-IV soils.

Livestock Production. Little significant change occurred on either model farm with an increase in corn price of 27 cents. The effect of an increase in corn price without an increase in livestock price is one of reduced net returns on the grain which is fed. Consequently, slightly fewer cropland acres were used for feed crops at the lower wheat prices and the size of the livestock enterprise was adjusted accordingly.

A stock-cow herd was maintained on both model farms at all wheat prices. In addition, at medium-to-high wheat prices, 400-pound calves were purchased to be grown out and marketed at 700-pound weights. The biggest change in the livestock enterprise operations was the sale of 400-pound calves at low wheat prices in contrast to the marketing of 700-pound calves at the lower corn price levels.

Very little difference occurred in grains and roughages fed. Wheat was still fed at the lowest range of wheat prices, but the quantity fed was greatly reduced from the quantities fed at the lower corn price levels.

Labor

Labor was not expected to be a limiting resource, particularly on the 640-acre model farm. As farms increase in size and become more intensively farmed, capital substitutes for labor at an increasing rate. In addition, farmers work longer days as well as on Sundays to make up for labor lost due to wet or otherwise inclement weather. Often, some family labor is available, other than the operator himself, if only for emergency needs.

Results showed that total annual labor needs were neither a crucial nor a limiting factor—total labor was in surplus. The minimum annual labor requirements, on the 640-acre farm, amounted to 28% of the labor available and 52% on the 1,600-acre model farm. The maximum labor requirements on the small farm were 52.5% of the available labor and 82% on the 1,600-acre farm.

The labor available during the planting and har-

Table 17. Resident Labor Use by Periods for the Optimum Farm Plan at Specified Wheat and Corn Prices, 640-Acre Model Farm, Hughes and Sully Counties

Labor Periods	Corn Price per Bushel	Hours of Labor Available	Resident Labor Use at the Following Ranges of Wheat Prices					
			$.36 to $.57	$.74 to $.77	$1.01 to $1.42	$1.53 to $1.55	$1.56 to $3.50	$3.21
					Hours			
Nov. 16 to March 15	69c	899	510.2	185.7	140.7	119.6	119.6	96.3
March 16 to April 30	69c	474	330.4	297.8	302.4	292.0	176.7	169.3
May 1 to July 15	69c	920	199.0	217.9	230.0	237.1	267.8	258.0
July 16 to Sept. 30	69c	924	514.4	517.3	449.3	488.5	473.1	464.4
Oct. 1 to Nov. 15	69c	377	334.2	119.9	55.6	41.0	41.0	25.1
					Hours			
Total Annual		**3,594**	**1,888.2**	**1,338.6**	**1,178.0**	**1,178.2**	**1,078.2**	**1,013.1**
			Resident Labor Use at the Following Ranges of Wheat Prices					
			$.36 to $.67	$.94 to $.95	$1.11 to $1.37	$1.49 to $1.53	$1.56 to $3.20	$3.21
					Hours			
Nov. 16 to March 15	83c	899	145.7	161.1	145.7	130.9	119.6	96.3
March 16 to April 30	83c	474	151.3	184.4	303.4	297.8	176.7	169.3
May 1 to July 15	83c	920	727.0	628.4	233.3	231.6	267.8	258.0
July 16 to Sept. 30	83c	924	283.9	375.0	466.5	462.8	473.1	464.4
Oct. 1 to Nov. 15	83c	377	377.0	377.0	56.4	45.7	41.0	25.1
					Hours			
Total Annual		**3,594**	**1,684.9**	**1,725.9**	**1,205.3**	**1,168.8**	**1,078.2**	**1,013.1**
			Resident Labor Use at the Following Ranges of Wheat Prices					
				$.36 to $1.18	$1.22 to $1.29	$1.59 to $1.72	$1.73 to $1.80	$1.84 to $3.20
					Hours			
Nov. 16 to March 15	$1.10	899	140.2	140.1	119.6	119.6	119.6	
March 16 to April 30	$1.10	474	136.5	153.3	132.6	136.3	176.7	
May 1 to July 15	$1.10	920	752.1	695.7	697.9	661.6	267.8	
July 16 to Sept. 30	$1.10	924	275.1	294.8	329.8	341.9	473.1	
Oct. 1 to Nov. 15	$1.10	377	377.0	377.0	377.0	377.0	41.0	
					Hours			
Total Annual		**3,594**	**1,680.9**	**1,660.9**	**1,656.9**	**1,636.4**	**1,078.2**	

vesting seasons was generally adequate to meet the needs. The minimum annual labor needed during the planting and harvesting seasons on the 640-acre farm, amounted to 34% of that available compared with 58% for the maximum use. In constrast, labor was more fully utilized on the 1,600-acre farm, since the annual minimum utilization of the available labor was 57.1% compared with 86.8% for the maximum.

A relatively small amount of labor was hired during the October 1 to November 15 period. Thirty-one hours of labor were hired on the 640-acre farm with corn priced at 83 cents per bushel and wheat prices of 95 cents per bushel and less and, also, at wheat prices of $1.80 per bushel and less with corn priced at $1.10 per bushel. Forty-six hours of labor were hired on the 1,600-acre farm at a corn price of 69 cent per bushel. Hired labor use increased to 66 hours at both of the higher corn prices and at successively higher wheat prices.

Labor restrictions did affect the cropping system. At relatively low wheat prices, continuous grain sorgsum was the most profitable crop alternative at all three corn price levels. Thus, if labor were free and unlimited, only grain sorghum would be expected to be grown until the break even price of the other crop alternatives were reached. However, since labor was neither free nor unlimited, the second best crop alternatives were selected after the maximum acreage of grain sorghum was planted.

Labor use by periods for the various wheat and feed grain price levels for each model farm is shown in Tables 17 and 18.

Capital

Short-term capital and credit was assumed to be ample and, thus, was not a critical factor. The annual capital requirements varied between a low of $13,340 and a high of $45,550 on the 640-acre farm and between $36,290 and $86,000 on the larger farm when corn was priced at 69 cents. The range in capital needs was reduced at the higher corn prices, because at the higher corn prices the feeder operation was much smaller. The purchase of feeder calves, when the price of wheat was low, increased the annual capital needs by two to three times that needed at high wheat prices.

Table 18. Resident Labor Use by Periods for the Optimum Farm Plan at Specified Wheat and Corn Prices, 1,600-Acre Model Farm, Hughes and Sully Counties

Labor Periods	Corn Price Per Bushel	Hours of Labor Available	Resident Labor Use at the Following Ranges of Wheat Prices					
			$.36 to $.45	$.62 to $.85	$1.15 to $1.30	$1.48 to $1.62	$1.63 to $3.59	$3.72
					Hours			
Nov. 16 to March 15	69c	1,159	1,034.4	577.6	522.6	465.9	465.9	427.1
March 16 to April 30	69c	621	621.0	583.1	593.4	576.9	388.5	376.5
May 1 to July 15	69c	1,177	536.6	461.8	473.7	466.2	516.4	500.8
July 16 to Sept. 30	69c	1,122	1,027.7	1,101.9	1,122.0	1,026.8	1,001.6	954.7
Oct. 1 to Nov. 15	69c	484	484.0	203.0	176.7	137.5	137.5	112.8
					Hours			
Total Annual		**4,563**	**3,703.7**	**2,927.4**	**2,888.4**	**2,673.3**	**2,509.9**	**2,371.9**
			Resident Labor Use at the Following Ranges of Wheat Prices					
			$.36 to $.42	$.52 to $.71	$.95 to $1.26	$1.48 to $1.62	$1.63 to $3.58	$3.59
					Hours			
Nov. 16 to March 15	83c	1,159	787.9	513.5	531.9	465.9	465.9	427.1
March 16 to April 30	83c	621	621.0	452.0	603.8	576.9	388.5	376.5
May 1 to July 15	83c	1,177	845.1	949.1	472.9	466.2	516.4	500.8
July 16 to Sept. 30	83c	1,122	1,003.1	856.6	1,083.4	1,026.8	1,001.6	954.7
Oct. 1 to Nov. 15	83c	484	484.0	484.0	186.0	137.5	137.5	112.8
					Hours			
Total Annual		**4,563**	**3,741.1**	**3,255.2**	**2,878.0**	**2,673.3**	**2,509.9**	**2,371.9**
			Resident Labor Use at the Following Ranges of Wheat Prices					
			$.36 to $.88	$1.12 to $1.23	$1.38 to $1.62	$1.63 to $1.73	$1.74 to $1.84	$1.85 to $3.53
					Hours			
Nov. 16 to March 15	$1.10	1,159	480.6	483.2	465.9	465.9	465.9	465.9
March 16 to April 30	$1.10	621	434.8	427.4	411.9	338.6	346.6	388.3
May 1 to July 15	$1.10	1,177	968.4	970.7	980.2	999.7	922.4	516.4
July 16 to Sept. 30	$1.10	1,122	787.4	837.9	850.3	840.5	866.3	1,001.6
Oct. 1 to Nov. 15	$1.10	484	484.0	484.0	484.0	484.0	484.0	137.5
					Hours			
Total Annual		**4,563**	**3,155.2**	**3,203.2**	**3,192.3**	**3,128.7**	**3,085.2**	**2,509.7**

SUMMARY

The purpose of this publication is to provide some results of a research study in which optimum farm plans were determined for a 640-acre and a 1,600-acre wheat farm in Hughes and Sully Counties.

Variable price and linear programming techniques were used to determine the optimal farm plans at alternative price combinations of wheat and feed grains. Optimal farm plans were determined at three levels of corn prices ranging from a low of 69 cents to a high of $1.10 per bushel, while wheat prices were varied from zero to approximately $3.20 per bushel.

Results of the programming analysis indicate net returns would be greatest with the model farms oriented toward the production of cash grain. A cattle enterprise was maintained on both model farms, but it was largely supplementary in nature, using labor, native hay, and range which might not otherwise have been used. A small amount of cropland was used to produce grain, silage, and hay for the livestock enterprise. A substantial number of 400-pound calves, to be grown and marketed at 700-pound weights, were purchased at low feed grain and wheat prices. A stock-cow herd usually constituted the main part of the livestock enterprise supplemented with additional numbers of purchased calves.

The main cash crops were spring and winter wheat, flax, corn, and grain sorghum, each having a different break even price, depending upon the yield ratios and production costs on the two soils groups. Production costs were somewhat lower on the 1,600-acre model farm, thus, the break even price of the crop alternatives was lower than on the 640-acre farm.

The break even price is the key in knowing which crops are the most profitable at the various price levels. Given the objective to optimize net returns to land, labor, and management, the strategy is then to employ the break even prices of each crop so as to obtain the maximum acreage of the most profitable crops on each soils group.

The crops on Soils Group III-IV had a different set of break even prices, as the yields and costs were different. Although this soils group comprised only 11% of the total cropland, the crop rotations were generally similar to those of Soils Group I-II with few exceptions. One exception, at low wheat and feed grain prices, was the use of these soils for tame pasture. The other most notable exception was the growing of winter wheat, since its yield and comparative costs made it slightly more profitable than spring wheat. Winter wheat production reached its maximum possible at prices of about $1.50 per bushel on both farms.

Corn and grain sorghum were the two competing row crops. Grain sorghum, due to the comparative yield and cost of production, was the more profitable crop and, thus, had a lower break even price.[4]

Neither corn nor grain sorghum, although profitable, could compete for the use of cropland at a feed grain price of 69 cents per bushel. With wheat and feed grain prices at low levels, feed crops and tame pasture for the livestock enterprise, and flax production for the cash grain market were more profitable. An increase to 83 cents per bushel raised the net returns from both corn and grain sorghum to a level at which each could successfully compete with the relatively high cattle prices and crop rotations which contained flax. Grain sorghum was produced as a cash grain on the 640-acre model farm until wheat reached a price of $1.11 per bushel, and on the 1,600-acre farm until wheat reached 95 cents per bushel. As the feed grain price rose to $1.10 per bushel, grain sorghum and corn could compete for cropland at much higher wheat prices. Grain sorghum was produced at a wheat price as high as $1.80 per bushel on the 640-acre farm, and on the 1,600-acre farm until wheat reached a price of $1.84 per bushel.

The break even price for flax was $1.08 and 94 cents per bushel, respectively, on the 640- and 1,600-acre model farms. Thus, with a market price of $2.30 per bushel, flax was the most profitable competing crop at low wheat and feed grain prices. However, continuous flax was not allowed; it could be grown only in rotation with other crops and, thus, was often grown in rotation with the next best crop alternatives. Flax lost its competitive price advantage to a spring wheat-fallow rotation on the 640-acre farm when wheat reached $1.56 per bushel and on the 1,600-acre farm at a wheat price of $1.63 per bushel.

The maximum wheat acreage allowable amounted to half of the cropland acreage—all cropland could go to summer fallow and wheat. The maximum production possible was 5,452 bushels on the 640-acre farm and 9,052 bushels on the 1,600-acre farm, which included spring wheat only on Soils Group I-II and winter wheat on Soils Group III-IV. About 98% of

[4]Corn only was used in crop rotations to reduce the number of allowable alternatives and, thus, facilitate computer programming. An assumption was made that grain sorghum would substitute for corn in rotations which appeared in the farm plans, provided grain sorghum is the more profitable crop. Grain sorghum returned about $6.50 on the 640-acre and $7.90 on the 1,600-acre model farm at a corn price of 69 cents per bushel.

the potential wheat production was reached at prices of about $1.55 to $1.80 per bushel, depending upon the size of model farm and the corn price.

Some wheat was produced at all prices, but at the low prices it was fed to livestock. Whether corn, sorghum, or wheat is fed depends upon the relative prices. With corn priced at 69 cents per bushel, the total wheat production was fed on the 640-acre farm at prices of 57 cents per bushel and less, and on the 1,600-acre farm, wheat was fed at prices of 45 cents per bushel and less. As the price of corn increased to 83 cents per bushel, very little wheat was produced on the 640-acre farm at prices of 67 cents per bushel or less and it was fed to livestock. As the corn price was raised to $1.10 per bushel, wheat production continued to decline on the 640-acre farm—even at a price of $1.18 per bushel, and, it was also used as livestock feed. Only a part of the wheat production was fed on the 1,600-acre farm.

The livestock enterprise consisted of raising calves to stocker cattle weights. Most of the calves were purchased in the fall, and some calves were raised from a stock-cow herd. Group III-IV soils were seeded for pasture when the price of corn was 69 cents per bushel, and wheat prices were below 85 cents per bushel.

Labor was more fully utilized on the 1,600-acre farm compared with the 640-acre model farm. Minimum annual labor use on the 640-acre farm amounted to 34% of the available labor compared with 57% on the 1,600-acre farm. Maximum annual labor use on the small farm was 58% compared with nearly 87% on the large farm. Some labor was hired during the fall and early winter months. Labor restrictions affected the cropping system. Under conditions of low wheat prices and unlimited free labor, all or nearly all the cropland acreage would be planted to grain sorghum. But, with limited labor during the harvesting periods, grain sorghum acreage was limited with the second best crop alternative sharing some of the cropland.

The optimal farm plans presented herein are the results of computer programming using specific assumptions with regard to farm size and cropland acreage, crop yields, costs, commodity market prices, and other such factors. Consequently, these results cannot be construed as being representative of all 640-acre and 1,600-acre farms or a specific farm in this two-county area. The results, however, do present the most profitable farm plans under the stated assumptions and may serve as a guide for determining profitable farm plans under a similar cost and price structure.

APPENDIX

Appendix Table 1. Crops and Crop Rotations Allowed as Activities by Soils Groups, Hughes and Sully Counties

Rotation	Soil Groups I & II	Soil Groups III & IV
Corn	X	
Sorghum	X	
Summer Fallow-Spring Wheat-Flax	X	
Summer Fallow-Spring Wheat-Corn	X	
Flax-Spring Wheat-Barley-Oats-Alfalfa (3 years)	X	
Oats-Alfalfa (3 years)	X	
Summer Fallow-Spring Wheat-Flax-Corn	X	
Summer Fallow-Spring Wheat-Spring Wheat	X	
Summer Fallow-Spring Wheat-Barley-Corn	X	
Summer Fallow-Spring Wheat-Spring Wheat-Corn	X	
Summer Fallow-Spring Wheat-Oats-Corn	X	
Corn-Barley-Corn-Oats-Alfalfa (2 years)	X	
Corn-Spring Wheat-Corn-Oats-Alfalfa (2 years)	X	
Summer Fallow-Spring Wheat	X	X
Summer Fallow-Winter Wheat	X	X
Summer Fallow-Winter Wheat-Corn-Oats-Alfalfa (4 years)		X
Summer Fallow-Spring Wheat-Corn-Oats-Afalfa (3 years)		X
Summer Fallow-Winter Wheat-Corn-Oats-Alfalfa (3 years)		X
Spring Wheat-Corn-Oats-Alfalfa (3 years)		X
Spring Wheat-Corn-Flax-Alfalfa (3 years)		X
Flax-Corn-Oats-Alfalfa (3 years)		X
Rye-Corn-Oats-Alfalfa (4 years)		X
Summer Fallow-Spring Wheat-Corn-Flax-Alfalfa (3 years)		X
Grass		X

Appendix Table 2. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices: $.36 to $.57	$.74 to $.77	$1.01 to $1.42	$1.53 to $1.55	$1.56 to $3.20	$3.21
Soil Group I-II						
Oats	61.9					
Alfalfa	185.6					
Flax	47.8	125.3	130.0	128.1		
Summer Fallow	47.8	125.3	130.0	128.1	192.1	193.7
Spring Wheat	47.8	125.3	130.0	128.1	192.1	193.7
Sorghum		15.2	.9	6.8	6.8	3.5
Total Acres	**390.9**	**391.1**	**390.9**	**391.1**	**391.0**	**390.9**
Soil Group III-IV						
Grass	48.0	48.0				
Oats			6.9			
Corn			6.9			
Flax			6.9			
Alfalfa			20.6			
Spring Wheat			6.9	24.0	24.0	24.0
Summer Fallow			6.9	24.0	24.0	24.0
Total Acres	**48.0**	**48.0**	**48.2**	**48.0**	**48.0**	**48.0**

Appendix Table 3. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 69 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices					
	$.36 to $.45	$.62 to $.85	$1.15 to $1.30	$1.48 to $1.62	$1.63 to $3.59	$3.72
Soil Group I-II						
Oats	89.5					
Alfalfa	268.5					
Flax	97.0	206.3	209.2	209.3		
Summer Fallow	97.0	206.3	209.2	209.3	314.0	316.5
Wheat	97.0	206.3	209.2	209.3	314.0	316.5
Sorghum		30.0	21.3	21.0	21.0	16.0
Total Acres	**649.0**	**648.9**	**648.9**	**648.9**	**649.0**	**649.0**
Soup Group III-IV						
Grass	80.0	80.0				
Corn			11.4			
Flax			11.4			
Alfalfa			34.3			
Wheat			11.4	40.0	40.0	40.0
Summer Fallow			11.4	40.0	40.0	40.0
Total Acres	**80.0**	**80.0**	**79.9**	**80.0**	**80.0**	**80.0**

Appendix Table 4. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 640-Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices					
	$.36 to $.67	$.94 to $.95	$1.11 to $1.37	$1.49 to $1.53	$1.56 to $3.20	$3.21
Soil Group I-II						
Corn	101.2					
Flax	5.9	31.3	129.4	129.5		
Summer Fallow	5.9	31.3	129.4	129.5	192.1	193.7
Wheat	5.9	31.3	129.4	129.5	192.1	193.7
Sorghum	272.0	297.1	2.7	2.5	6.8	3.5
Total Acres	**390.9**	**391.0**	**390.0**	**391.0**	**391.0**	**390.9**
Group III-IV						
Oats	8.0					
Flax	8.0	8.0	6.9	3.8		
Corn	8.0	8.0	6.9	3.8		
Alfalfa	24.0	24.0	20.6	11.5		
Summer Fallow			6.9	14.3	24.0	24.0
Wheat		8.0	6.9	14.3	24.0	24.0
Total Acres	**48.0**	**48.0**	**48.2**	**47.7**	**48.0**	**48.0**

Appendix Table 5. Cropland Use by Soil Groups at Various Levels of Wheat Prices and 83 Cents per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices					
	$.36 to $.42	$.52 to $.71	$.95 to $1.26	$1.48 to $1.62	$1.63 to $3.58	$3.59
Soil Group I-II						
Alfalfa	154.2					
Corn	51.4					
Oats	51.4					
Flax	59.0	89.3	208.6	209.3		
Summer Fallow	7.6	89.3	208.6	209.3	314.0	316.5
Wheat	59.0	89.3	208.6	209.3	314.0	316.5
Sorghum	266.6	381.2	23.4	21.0	21.0	16.0
Total Acres	**649.2**	**649.1**	**649.2**	**648.9**	**649.0**	**649.0**
Soil Group III-IV						
Oats	13.3	13.3				
Corn	13.3	13.3	13.3			
Flax	13.3	13.3	13.3			
Alfalfa	40.0	40.0	40.0			
Wheat			13.3	40.0	40.0	40.0
Summer Fallow				40.0	40.0	40.0
Total Acres	**79.9**	**79.9**	**79.9**	**80.0**	**80.0**	**80.0**

Appendix Table 6. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 640 Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices				
	$.36 to $1.18	$1.22 to $1.29	$1.59 to $1.72	$1.73 to $1.80	$1.84 to $3.20
Soil Group I-II					
Corn	126.6	14.0			
Sorghum	264.4	334.9	348.1	319.3	6.8
Flax		14.0			
Wheat		14.0	21.5	35.9	192.1
Summer Fallow		14.0	21.5	35.9	192.1
Total Acres	**391.0**	**390.9**	**391.1**	**391.1**	**391.0**
Soil Group III-IV					
Oats	1.1				
Flax	7.0	6.9			
Corn	7.0	6.9			
Alfalfa	21.0	20.6			
Summer Fallow	5.9	6.9	24.0	24.0	24.0
Wheat	5.9	6.9	24.0	24.0	24.0
Total Acres	**47.9**	**48.2**	**48.0**	**48.0**	**48.0**

Appendix Table 7. Cropland Use by Soil Groups at Various Levels of Wheat Prices and $1.10 per Bushel for Corn, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop	Crop Acres at the Following Wheat Prices					
	$.36 to $.88	$1.12 to $1.23	$1.38 to $1.62	$1.63 to $1.73	$1.74 to $1.84	$1.85 to $3.53
Soil Group I-II						
Flax	82.5	83.6	81.5			
Summer Fallow	82.5	83.6	81.5	122.2	152.9	314.0
Wheat	82.5	83.6	81.5	122.2	152.9	314.0
Sorghum	401.5	398.2	404.6	404.6	343.2	21.0
Total Acres	**649.0**	**649.0**	**649.1**	**649.0**	**649.0**	**649.0**
Group III-IV						
Oats	13.3	5.9				
Flax	13.3	5.9				
Corn	13.3	5.9				
Alfalfa	40.0	17.7				
Winter Wheat		22.3	40.0	40.0	40.0	40.0
Summer Fallow		22.3	40.0	40.0	40.0	40.0
Total Acres	**79.9**	**80.0**	**80.0**	**80.0**	**80.0**	**80.0**

Appendix Table 8. Crop Rotations on all Soil Groups at Specified Wheat and Corn Prices, 640-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel					
		$.36 to $.57	$.59 to $.70	$1.01 to $1.42	$1.53 to $1.55	$1.56 to $3.20	$3.21
		Acres					
Grass	69c	48.0	48.0				
Flax, Corn, Oats, Alfalfa (3 years)	69c						
Summer Fallow, Spring Wheat, Flax	69c	143.5	375.8	390.1	384.2		
Sorghum	69c		15.2	.9	6.8	6.8	3.5
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)	69c			48.0			
Sumer Fallow, Spring Wheat	69c				48.0	432.2	435.5
Oats, Alfalfa (3 years)	69c	247.5					
		Range of Wheat Prices per Bushel					
		$.36 to $.67	$.94 to $.95	$1.11 to $1.37	$1.49 to $1.53	$1.56 to $3.20	$3.21
		Acres					
Summer Fallow, Spring Wheat, Flax, Corn	83c	23.7					
Corn	83c	95.3					
Flax, Corn, Oats, Alfalfa (3 years)	83c	48.0					
Sorghum	83c	272.0	297.1	2.7	2.5	6.8	3.5
Wheat, Corn, Flax, Alfalfa (3 years)	83c		48.0				
Summer Fallow, Spring Wheat, Flax	83c		93.9	388.3	388.5		
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)	83c			48.0	26.9		
Summer Fallow, Spring Wheat	83c				21.1	432.2	435.5
		Range of Wheat Prices per Bushel					
		$.36 to $1.18	$1.22 to $1.29	$1.59 to $1.72	$1.73 to $1.80	$1.84 to $3.20	
		Acres					
Corn	$1.10	126.6					
Flax, Corn, Oats, Alfalfa (3 years)	$1.10	6.5					
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)	$1.10	41.6	48.0				
Sorghum	$1.10	264.4	334.9	348.1	319.3	6.8	
Summer Fallow, Spring Wheat, Flax, Corn	$1.10		56.1				
Summer Fallow, Spring Wheat	$1.10			90.0	119.7	432.2	

Appendix Table 9. Crop Rotations on All Soil Groups at Specified Wheat and Corn Prices, 1,600-Acre Model Farm, Hughes and Sully Counties

Crop Rotation	Corn Price per Bushel	Range of Wheat Prices per Bushel $.36 to $.45	$.62 to $.85	$1.15 to $1.30	$1.48 to $1.62	$1.63 to $3.59	$3.72
Oats, Alfalfa (3 years)	69c	358.0					
Grass	69c	80.0	80.0				
Summer Fallow, Spring Wheat, Flax	69c	291.0	619.0	627.7	628.0		
Sorghum	69c		30.0	21.3	21.0	21.0	16.0
Summer Fallow, Spring Wheat, Corn, Flax, Alfalfa (3 years)	69c			80.0			
Summer Fallow, Winter Wheat	69c				80.0	80.0	80.0
Summer Fallow, Spring Wheat	69c					628.0	633.0

		Range of Wheat Prices per Bushel $.36 to $.42	$.52 to $.71	$.95 to $1.26	$1.48 to $1.62	$1.63 to $3.58	$3.59
Flax, Spring Wheat, Corn, Oats, Alfalfa, (3 years)	83c	359.5					
Flax, Corn, Oats, Alfalfa (3 years)	83c	80.0	80.0				
Summer Fallow, Spring Wheat, Flax	83c	22.9	267.8	625.7	628.0		
Sorghum	83c	266.6	381.2	23.4	21.0	21.0	16.0
Spring Wheat, Corn Flax, Alfalfa, (3 years)	83c			80.0			
Summer Fallow, Winter Wheat	83c				80.0	80.0	80.0
Summer Fallow, Spring Wheat	83c					628.0	633.0

		Range of Wheat Prices per Bushel $.36 to $.88	$1.12 to $1.23	$1.38 to $1.62	$1.63 to $1.73	$1.74 to $1.84	$1.85 to $3.53
Flax, Corn, Oats, Alfalfa (3 years)	$1.10	80.0	35.5				
Summer Fallow, Spring Wheat, Flax	$1.10	247.6	250.8	244.4			
Sorghum	$1.10	401.5	398.2	404.6	404.6	343.2	21.0
Summer Fallow, Winter Wheat	$1.10		44.5	80.0	80.0	80.0	80.0
Summer Fallow, Spring Wheat	$1.10				244.4	305.8	628.0